

REMARKS

By this response, Claims 25, 39, 41 and 42 have been amended. Claims 25 and 28-45 are pending in the application. Favorable consideration is respectfully requested in view of the following remarks.

Rejection Under 35 U.S.C. § 103

Claims 25 and 28-45 stand rejected under 35 U.S.C. § 103(a) over U.S. Patent No. U.S. Patent No. 5,935,373 to Koshimizu ("Koshimizu") in view of U.S. Patent No. 4,439,401 to Voll et al. ("Voll"). The reasons for the rejection are stated on pages 2-8 of the Official Action. The rejection is respectfully traversed.

Claim 25, as amended, recites a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The gas injector comprises, inter alia, "gas injector body of dielectric material and sized to extend through a chamber wall of the processing chamber such that a planar axial distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the planar axial distal end surface of the gas injector body" (emphasis added). In the exemplary embodiment of the gas injector shown in Figure 3A, the axial distal end surface of the gas injector body (i.e., the bottom surface) is planar.

The Official Action acknowledges that Koshimizu fails to suggest a gas injector comprising a body of dielectric material. The Official Action asserts that it

would have been obvious to replace Koshimizu's gas supply port with Voll's gas injector shown in Figure 10.

Voll discloses nozzles designed for producing carbon black by spraying a hydrocarbon containing liquid carbon black feedstock (column 1, lines 12-17). The nozzles are used spray the feedstock by means of a propellant gas into a stream of hot reaction gases produced by burning a fuel. Applicants submit that Voll does not qualify as analogous prior art with respect to the claimed gas injector. According to M.P.E.P. § 2141.01(a), for a reference to qualify as analogous prior art under 35 U.S.C. § 103, it must either (1) be in the field of applicant's endeavor, or, if not, (2) be reasonably pertinent to the particular problem with which the inventor was concerned. Voll fails to meet either of these two requirements.

The claimed gas injector is adapted for supplying process gas to a plasma processing chamber. The gas injector is directed to the problem of improving processing uniformity and efficiency for processing semiconductor substrates in such plasma processing chambers. In stark contrast, Voll is not (1) directed to the field of semiconductor plasma processing, which involves vacuum processing conditions and the need for using highly pure materials to avoid the contamination of substrates being processed in the chamber, or (2) reasonably pertinent to the problem of improving processing uniformity and efficiency for processing semiconductor substrates in such plasma processing chambers. Thus, because Voll does not qualify as analogous prior art with respect to the claimed subject matter, the rejection should be withdrawn.

Moreover, Voll fails to cure the deficiencies of Koshimizu with respect to the gas injector recited in Claim 25 for at least the following reasons. Firstly, Voll does

not disclose or suggest that the nozzle is made from a dielectric material, as recited in Claim 25.

Secondly, none of the nozzle constructions shown in Figures 1-10 of Voll includes a body having a planar axial distal end surface and a plurality of the gas outlets located in the planar axial distal end surface. For example, the nozzle 4 shown in Figure 10 of Voll includes no gas outlets in the planar axial distal end surface (i.e., the left-most surface of the nozzle 4). The nozzle shown in Figure 9 of Voll includes a pointed distal end with no gas outlets. The nozzles shown in Figures 6 and 8 of Voll each have a conical distal end surface, not a planar axial distal end surface, as recited in Claim 25. Accordingly, replacing Koshimizu's gas supply port with Voll's nozzle would not result in a gas injector including every feature recited in Claim 25. According to M.P.E.P. § 2143.03, however, "to establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art." Because the applied references do not suggest all of the features recited in Claim 25, they do not support the alleged *prima facie* obviousness.

Claims 28-38 and 43-45, which depend from Claim 25, are also patentable over the applied references for at least the same reasons as those for which Claim 25 is patentable.

Independent Claim 39, as amended, recites a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The gas injector comprises, inter alia, gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber and a cylindrical bore adapted to supply gas to the gas outlets.

The cylindrical bore is defined by a sidewall and an endwall, which extends radially inwardly from the sidewall. The gas outlets include a center gas outlet extending from the endwall in the axial direction and a plurality of angled gas outlets extending from the endwall at an acute angle to the axial direction. The gas outlets are located in the axial distal end surface of the gas injector body. The gas injector also comprises an annular flange having a surface adapted to overlie and contact an outer surface of the chamber wall; and a first O-ring in the surface of the flange for sealing against the outer surface of the chamber wall. The exemplary embodiment of the gas injector 22 shown in Figure 3A includes a flange 42. When the gas injector 22 is mounted to extend through a chamber wall of a processing chamber (see, e.g., Figure 1), the bottom surface of flange 42 shown in Figure 3A overlies and contacts an outer surface of the chamber wall (e.g., the top surface of the dielectric window 20 shown in Figure 1).

The Official Action acknowledges that Koshimizu does not suggest an annular flange having a surface adapted to overlie and contact an outer surface of a chamber wall; and a first O-ring in the surface of the flange for sealing against the outer surface of the chamber wall, as recited in Claim 39. However, the Official Action asserts that Voll cures the deficiencies of Koshimizu. Applicants disagree.

As discussed above, Voll is non-analogous prior art with respect to the claimed subject matter. Also, Voll's nozzle is not adapted to be used for semiconductor processing and the nozzle shown in Figure 10 does not include a center gas outlet extending in an axial direction from an endwall, which extends radially inwardly from a sidewall, where the endwall and sidewall define a cylindrical bore.

As another example, Voll's nozzle 4 shown in Figure 8 includes a hexagonal-shaped, flange-like portion (see Figure 7). Figure 11 of Voll shows the nozzle 4 situated at a sidewall of a furnace chamber 18. Voll does not suggest that the nozzle 4 shown in Figure 8 includes a flange having a surface adapted to overlie and contact an outer surface of a chamber wall; and a first O-ring in the surface of the flange for sealing against an outer surface of a chamber wall, as recited in Claim 39. Applicants submit that one having ordinary skill in the art would recognize that Voll's nozzle 4 is not constructed to be mounted to extend through a chamber wall of a plasma processing chamber such that the left, vertical surface of the flange-like portion contacts an outer surface of the chamber wall. At the least, such mounting of the nozzle would cover channels 3 formed in the head of the nozzle 4. It follows that Voll also does not suggest modifying the nozzle 4 shown in Figure 8 to include a first O-ring in a surface of the flange that overlies and contacts an outer surface of a chamber wall of a plasma processing chamber for sealing against the outer surface.

As another example, Voll's nozzle shown in Figure 9 does not include a center gas outlet extending in an axial direction from an endwall.

In short, Applicants submit that Voll fails to suggest any nozzle construction that includes the combination of features recited in Claim 39. Accordingly, even if Koshimizu's gas supply port was replaced with Voll's nozzle, this modification would not result in a gas injector that includes the combination of features recited in Claim 39. Thus, Claim 39 is patentable over the applied references. Claim 40, which depends from Claim 39, is also patentable over the applied references for at least the same reasons as those for which Claim 39 is patentable.

Claim 41, as amended, recites a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The gas injector comprises a gas injector body sized to extend through a chamber wall of the processing chamber such that an axial distal end surface of the gas injector body is exposed within the processing chamber. The gas injector body includes a plurality of gas outlets adapted to supply process gas into the processing chamber. The gas outlets are located in the axial distal end surface of the gas injector body. The gas injector body includes a uniform diameter central bore adapted to supply gas to the gas outlets. The central bore extends axially from an upper axial end face of the gas injector body, and is defined by a cylindrical sidewall and a circular, planar endwall extending between the cylindrical sidewall, where inlets of the gas outlets are located on the planar endwall. In the exemplary embodiment of the gas injector shown in Figure 3A, the gas outlets 46 extend from a circular, planar endwall extending between the cylindrical sidewall, and the inlets of the gas outlets 46 are located on the circular, planar endwall.

The Official Action acknowledges that Koshimizu fails to suggest a gas injector including a plurality of gas outlets adapted to supply process gas into a processing chamber, where the gas outlets are located in an axial distal end surface of the gas injector. However, the Official Action asserts that Voll cures the deficiencies of Koshimizu with respect to Claim 41. Applicants disagree.

As discussed above, Voll is non-analogous art with respect to the claimed subject matter. In addition, Voll's nozzle 4 shown in Figure 10 does not include a plurality of gas outlets having inlets located on a circular, planar endwall defining a uniform diameter central bore. The embodiments of Voll's nozzle 4 shown in Figures

6, 8 and 9, for example, also do not include a circular, planar endwall extending between a cylindrical sidewall, much less having inlets of a plurality of gas outlets located on the circular, planar endwall, as recited in Claim 41.

Accordingly, even if Koshimizu's gas supply port was replaced with Voll's nozzle, this modification still would not result in a gas injector including the combination of features recited in Claim 41. Thus, Claim 41 is patentable.

Lastly, independent Claim 42, as amended, recites a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The gas injector comprises, *inter alia*, gas injector body made of a dielectric material selected from the group consisting of quartz, alumina and silicon nitride and sized to extend through a chamber wall of the processing chamber such that a planar axial distal end surface of the gas injector body is exposed within the processing chamber. The gas injector body includes a plurality of gas outlets adapted to supply process gas into the processing chamber. The gas outlets are located in the planar axial distal end surface of the gas injector body.

The Official Action acknowledges that Koshimizu fails to suggest a gas injector comprising a body made of any one of the dielectric materials recited in Claim 42. For reasons discussed above, Voll is non-analogous art with respect to the claimed subject matter and also does not disclose or suggest a gas injector made from any one of dielectric materials as recited in Claim 42.

Secondly, none of the nozzles shown in Figures 1-10 of Voll includes a body having a plurality of gas outlets adapted to supply process gas into the processing chamber, where the gas outlets are located in a planar axial distal end surface of the

body. For example, the nozzle 4 shown in Figure 10 of Voll includes a flat distal end surface with no gas outlets. The nozzle 4 shown in Figure 9 of Voll does not include a flat distal end surface, much less a flat distal end surface with a plurality of gas outlets. The nozzles 4 shown in Figures 6 and 8 of Voll do not include a flat distal end surface, let alone a flat distal end surface with a plurality of gas outlets. The nozzles 4 shown in Figures 2 and 4 of Voll include a flat distal end surface with no gas outlets.

Accordingly, replacing Koshimizu's gas supply port with Voll's nozzle still would not result in a gas injector including the combination of features recited in Claim 42. Thus, Claim 42 is patentable.

Therefore, withdrawal of the rejection is respectfully requested.

Conclusion

For the foregoing reasons, allowance of the application is respectfully requested. If there are any questions concerning this response, the Examiner is respectfully requested to contact the undersigned at the number given below.

Respectfully submitted,

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